

## RESEARCH ARTICLE

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# Nursing physical workload and mental workload in intensive care units: Are they related?

Kolsoom Nasirizad Moghadam<sup>1</sup> | Minoo Mitra Chehrzad<sup>2</sup> | Shademan Reza Masouleh<sup>3</sup> | Maryam Maleki<sup>4</sup> | Abbas Mardani<sup>5</sup>  | Shahaboddin Atharyan<sup>6</sup> | Celia Harding<sup>7</sup>

<sup>1</sup>School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran

<sup>2</sup>Department of Paediatric Nursing, School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran

<sup>3</sup>Social Determinants of Health Research Centre (SDHRC), Guilan University of Medical Sciences, Rasht, Iran

<sup>4</sup>School of Nursing & Midwifery, Tehran University of Medical Sciences, Tehran, Iran

<sup>5</sup>Nursing Care Research Center, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran

<sup>6</sup>Department of Nursing, School of Nursing and Midwifery, Iranshahr University of Medical Sciences, Iranshahr, Iran

<sup>7</sup>Division of Language and Communication Science, City, University of London, London, UK

## Correspondence

Abbas Mardani, Nursing Care Research Center, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran.  
Email: mardani.a@iums.ac.ir

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## Abstract

**Aim:** In order to ensure patient safety and quality of care, it is important to consider factors which may impact on nursing workloads. This study aimed to investigate the simultaneous physical and mental workload and any relationships between these concepts on nurses working in intensive care units.

**Design:** A cross-sectional design was undertaken.

**Method:** Participants were nurses ( $N = 105$ ) recruited from six adult intensive care units which met the inclusion criteria. Nursing Activities Score (NAS) to measure physical workload and NASA Task Load Index (NASA-TLX) to measure mental workload were used. Data were collected for each participating nurse in three shifts (morning, evening and night). Data were analysed using bivariate correlation and multivariable linear regression analysis.

**Results:** The mean ( $SD$ ) of nurses' physical and mental workload was 72.84% (22.07%) and 70.21 (12.36), respectively. A significant relationship between physical and mental workload ( $p < .001$ ) was identified.

## KEYWORDS

ICU, intensive care unit, mental workload, nurse, physical workload

## 1 | BACKGROUND

Nursing workload is a significant factor which can impact on patient safety and quality of nursing services in the hospital environment

(Aprilia et al., 2019; Pereira Lima Silva et al., 2020). The nursing workload is defined as the necessary level of core clinical skills required in the performance of daily nursing activities (Tubbs-Cooley et al., 2019). The skills required will vary according to the type of

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clinical provision where nurses are deployed in a hospital setting (Fagerström et al., 2018). Within the hospital setting, the intensive care unit (ICU) is designed as a specialist provision with comprehensive services and complex equipment to provide critical care for patients with life-threatening conditions (Aprilia et al., 2019). Nurses working in the ICU spend more time directly caring for patients and have many responsibilities such as constantly paying attention to patients' needs, interacting with their families and making decisions in critical situations. Therefore, they tolerate a higher workload than nurses on other wards (Chang & Hsiu-Hui, 2019; Mohammadi et al., 2015; Restuputri et al., 2019).

High workloads can have negative consequences for nurses and patients on ICUs (Hoonakker et al., 2011). Increased nursing workload can cause burnout and thereby reduce the well-being of nurses (Waddill-Goad, 2019). Also, it can lead to less time to perform caring tasks in the ICU leading to various negative outcomes for patients including increasing medication errors, patient falls, nosocomial infections and patient mortality (Carlesi et al., 2017; Liu et al., 2012).

Workload includes both physical and mental elements which combine and contribute to an individual's level of performance in the work environment (Restuputri et al., 2019). The physical workload is determined by physical skills such as moving and handling patients and drug administration (Amin et al., 2014). The mental workload includes receiving, understanding and interpreting information, making decisions, concentrating and interacting with patients and their families (Amin et al., 2014; Restuputri et al., 2019). In the literature, features of physical and mental workload can impact on and influence each other. Mental workload involves subjective processes and can affect physical skills causing fatigue and functional errors (Mehta & Agnew, 2012; Restuputri et al., 2019). Additionally, increasing physical effort requires mental demands that can reduce concentration and accuracy, thereby reducing a nurse's efficiency over time (Mehta & Agnew, 2012).

Features of physical workload and the increased impact on nurses can be observed, but the observation of increased mental workload is more difficult to clearly identify because it involves factors such as attention, feelings and the mental demands of work which are harder to see (Aprilia et al., 2019). Therefore, a simultaneous evaluation of physical and mental workloads can be useful in the provision of gaining a better understanding of nursing workload (Koca et al., 2015). However, very few studies have investigated both physical workload and mental workload for nurses in ICUs at the same time (Hoonakker et al., 2011) and the literature in this area of nursing workload balance is small. This study aimed to investigate the simultaneous physical and mental workload and any relationships between these concepts as experienced by nurses working in ICUs. The research questions were as follows:

- What is the amount of physical workload nurses experience when working in ICUs?
- What is the amount of mental workload nurses experience when working in ICUs?
- Is there a relationship between physical and mental workload for

nurses working in ICUs?

## 2 | METHODS

### 2.1 | Design and setting

A cross-sectional design was used to investigate the physical and mental workload of the ICU nurses working in the five hospitals in an urban area of Iran in 2015–2016.

### 2.2 | 2. Participants and recruitment

Inclusion criteria for the recruitment of nurses in this study were as follows: having an undergraduate/postgraduate degree in nursing science, having at least 1 year of work experience in an ICU, providing direct care to at least one patient and at least 4 hr in ICU per shift and providing signed consent to participate in the study. Exclusion criteria included discontinuation of nurses' cooperation with researchers.

To recruit the participants, the researchers referred to the study ICUs, then using face-to-face interviews reviewed the inclusion criteria of all 124 nurses who worked in the study ICUs. Nurses who met the study inclusion criteria and were interested to participate in this study were enrolled to participate.

### 2.3 | Measures

#### 2.3.1 | Demographic data questionnaires

The researchers developed demographic data questionnaires using the literature review to gather nurses' demographic information. This questionnaire included questions about individual and occupational characteristics including participant's gender, marital status, last educational degree, employment at the other healthcare centres, working experience, type of ICU, weekly working hours, and rest hours before and after the work shift. The validity of this questionnaire was confirmed using content (content validity index [CVI] = 92%, content validity ratio [CVR] = 89%) and face validity methods.

#### 2.3.2 | Nursing activities score

The Nursing Activities Score (NAS) was applied in the present study to evaluate the amount of physical workload that nurses experienced when working in ICUs. The NAS was developed by Miranda et al., (2003) to assess the nursing workload within an ICU setting. This questionnaire contains 23 items which are classified to seven main categories consisting of basic measures, cardiovascular support, ventilation support, neurological support, renal

support, metabolic support and specific intervention. The amount of time the nurse spends to provide direct patient care is the basis of the NAS scoring. The original version of the NAS was designed to measure nursing activities score during the 24-hr period, but Debergh et al., (2012) validated this tool for measuring nursing activities score per shift. The NAS calculates through the sum of scores of 23 items. The score ranges from 0%–177%. A NAS of 100 for a nurse indicates that the nurse spends 100% of her/his working time providing direct patient care. Thus, a NAS of 177% is equal to 1.77 of a full-time ICU nurse post (Debergh et al., 2012; Miranda et al., 2003).

In this study, the validity of the available Farsi version of the NAS (Alizadeh et al., 2015) was confirmed using CVI = 90% and CVR = 93%. Also, the reliability was confirmed using an equivalent reliability method in which two evaluators simultaneously completed the NAS for 17 nurses who were delivering nursing care for ICU patients (Pearson's correlation coefficient = 0.81 and  $p < .001$ ).

### 2.3.3 | NASA Task Load Index

NASA Task Load Index (NASA-TLX) was used in this study to measure the mental workload of nurses. The NASA-TLX is a mental (subjective) workload measure that was designed in the 1970s to evaluate pilot and air traffic controller workload stress (Hart & Staveland, 1988). The NASA-TLX is a multidimensional instrument that includes six dimensions: mental demands, physical demands, temporal demands, frustration, effort and performance. Twenty-step bipolar scales are applied to acquire ratings on all these dimensions. The possible scores are converted to a range from 0–100, and a higher rate indicates a higher mental workload (Hoonakker et al., 2011). The Farsi version of this instrument was translated by Mohammadi et al., (2013) and the validity of the instrument using face validity and the reliability applying Cronbach's alpha coefficients (0.84) were confirmed in Iranian ICU nurses.

### 2.4 | Data collection

Data were collected in six adult ICUs of 5 hospitals including two general ICUs, one neurosurgical ICU, one cardiac surgery ICU, one obstetric surgery ICU and one burns ICU during November 2015 to February 2016. The demographic questionnaire was completed by the nurse participants. The NAS was completed for each patient under the care of each clinical nurse who participated in the study in three shifts including morning, evening and night. The researchers using direct observation of nursing measures, the information in the nursing report and patients' records completed the NAS using a paper version. If a nurse were responsible for care of two patients, for each patient the separate NAS was completed, then the obtained NAS for each patient was summed together. Furthermore, the NASA-TLX was completed by each participating nurse in three shifts (morning, evening and night). Finally, the mean scores of the NAS

and the NASA-TLX in three shifts (morning, evening and night) were regarded as the nursing physical and mental workload, respectively.

### 2.5 | Research ethics committee approval

The required permission and approval for the research study to take place were provided by the hospital authorities prior to the investigations. Potential participants were informed of the study via department leads and were invited to contact the researchers directly if they were interested in taking part. All participants received information sheets defining the aims and the procedures of the study. All participants were informed that they would be required to provide signed consent, that confidentiality about their identities would be maintained and that they could withdraw from the study at any time without being penalized in any way. It was agreed that data from participants who withdrew would not be used in the analysis.

### 2.6 | Data analysis

The SPSS v. 25 software (IBM) was used for the data analysis. The mean and standard deviation for quantitative variables, and the frequency table for qualitative variables were used to describe participant characteristics. Bivariate correlation was conducted to explore the association between the physical workload and mental workload dimensions and the association among mental workload dimensions. Furthermore, to investigate the association between physical and mental workloads and the characteristics of nurses, multivariable linear regression analysis using the STATA software (Version 15; Stata Corporation) was used. The significance level was regarded as a  $p$ -value  $< .05$ .

## 3 | RESULTS

A total of 124 nurses from six intensive care units were invited to take part in this study. Of this number, 7 decided not to participate in the study, and 12 nurses did not meet the inclusion criteria as they undertook more management tasks and fewer direct patient care activities. In summary, 105 nurses participated.

In this study, 96.2% of nurses were female, 61% aged 30–40 years, 59% were married and 94.3% had nursing bachelor's degrees. Also, 17.1% of nurses were occupied at the other healthcare centres. Moreover, 45.7% of nurses worked in two general ICUs, 20% in a cardiac surgery ICU, 19% in a neurosurgical ICU, and the rest were employed in an obstetric surgery ICU (10.5%) and burns ICU (4.8%). The burns ICU had 14 nurses on roll, but due to the lack of hospitalized patients during the study, only 5 nurses were involved in direct patient care and therefore were eligible to participate. The rest of the nurse team were on standby for other units or declined participating in the study. Other occupational characteristics of the nurses are listed in Table 1.

**TABLE 1** Demographic characteristics of the participants

| Nurses' characteristics (N = 105)           | N     | %     |
|---------------------------------------------|-------|-------|
| Gender                                      |       |       |
| Female                                      | 101   | 96.2  |
| Male                                        | 4     | 3.8   |
| Age (year)                                  |       |       |
| <30                                         | 37    | 35.2  |
| 30–40                                       | 64    | 61    |
| >40                                         | 4     | 3.8   |
| Marital status                              |       |       |
| Married                                     | 62    | 59    |
| Single                                      | 43    | 41    |
| Educational level                           |       |       |
| Bachelor's degree                           | 99    | 94.3  |
| Master's degree                             | 6     | 5.7   |
| Being employed at the other centres         |       |       |
| Yes                                         | 18    | 17.1  |
| No                                          | 87    | 82.9  |
| Type of ICU                                 |       |       |
| General                                     | 48    | 45.7  |
| Surgical                                    | 52    | 49.5  |
| Burn                                        | 5     | 4.8   |
|                                             | Mean  | SD    |
| Work experience (year)                      | 8.14  | 4.72  |
| Weekly working hours                        | 48.21 | 8.59  |
| Resting before the work shift (hour)        | 33.43 | 13.44 |
| Resting after the work shift (hour)         | 30.91 | 11.73 |
| Number of patients under care in each shift | 1.61  | 0.40  |
| Patient characteristics (N = 509)           | N     | %     |
| Gender                                      |       |       |
| Male                                        | 288   | 56.6  |
| Female                                      | 221   | 43.4  |
| Admission sources                           |       |       |
| Operation room                              | 266   | 52.3  |
| Emergency ward                              | 176   | 34.6  |
| General wards                               | 55    | 10.7  |
| Other ICUs                                  | 12    | 2.4   |
| Patient treatment types                     |       |       |
| Surgical                                    | 321   | 63.1  |
| Medical                                     | 188   | 36.9  |
|                                             | Mean  | SD    |
| Age of patients (year)                      | 48.85 | 20.31 |
| Length of ICU stay (day)                    | 6.31  | 5.51  |

Physical workload and mental workload of nurses are presented in Table 2. The mean (SD) of the physical workload (NAS) in three shifts including morning, evening and night for 509 patients under the care of participating nurses was calculated at 72.84% (22.07%).

Furthermore, the results of mental workload (NASA-TLX) assessment in three shifts demonstrated that physical demand had a mean score of 77.73 (11.99) had the highest score and the perceived performance with the mean score of 45.53 (25.01) had the lowest score. In total, the dimensions of physical demand, effort, mental demand, temporal demand, frustration and the perceived performance had the highest to lowest scores, respectively. Also, the mean of the mental workload was 70.21 (12.36).

Bivariate correlations between the physical workload and mental workload of the nurse participants are summarized in Table 3. The results indicate that physical workload was significantly correlated with all dimensions of the mental workload and total mental workload experienced by nurses ( $p < .01$ ). Also, all aspects of mental workload and total mental workload were significantly correlated with each other ( $p < .05$ ) except mental and physical demands, with a perceived performance noted ( $p > .05$ ).

The multivariable linear regression analysis to explore the association between the physical workload and mental workload and the individual and occupational characteristics of ICU nurses are shown in Table 4. A direct significant association was found between the physical and mental workload both when the physical workload ( $b = 0.33$ , 95% CI = 0.17, 0.49) and/or when the mental workload ( $b = 0.41$ , 95% CI = 0.21, 0.60) was the outcome variable in the multivariable linear regression analysis. Also, an inverse significant association was found between the physical workload and working in obstetric surgery ICU ( $b = -29.94$ , 95% CI =  $-36.39$ ,  $-23.49$ ), burns ICU ( $b = -26.80$ , 95% CI =  $-41.22$ ,  $-21.14$ ), cardiac surgery ICU ( $b = -10.58$ , 95% CI =  $-16.51$ ,  $-4.65$ ) and neurosurgical ICU ( $b = -6.65$ , 95% CI =  $-11.25$ ,  $-2.05$ ). In addition, it was found a direct association between the physical workload of nurses and the number of patients under their care ( $b = 25.47$ , 95% CI = 19.60, 31.34). Moreover, an inverse relationship was seen between the mental workload of nurses and working in cardiac surgery ICU ( $b = -10.06$ , 95% CI =  $-16.73$ ,  $-3.40$ ).

## 4 | DISCUSSION

This study aimed to investigate the physical and mental workload simultaneously in ICUs as experienced by nurses. In addition, the relationship between them was examined.

In the present study, the mean NAS for physical workload of nurses was calculated at 72.84%. Physical workload for nurses in ICUs has been evaluated in previous studies in different countries. For instance, the NAS from a Spanish ICU providing care to three groups of patients (acute coronary syndrome, acute respiratory failure and sepsis) was estimated at 65.9% (Carmona-Monge et al., 2013). The findings of another study conducted in Belgium revealed that the mean of nursing physical workload using the NAS in ICUs per patient was 54.7% (Debergh et al., 2012). In addition, a cross-sectional study by Padilha et al., (2015) conducted in 19 ICUs in seven countries reported a diverse range of mean NAS between different countries with 44.5% (Spain) to 101.8% (Norway).

**TABLE 2** The physical and mental workload of ICU nurses

| Variable                   | Mean   | SD     | Median | Min    | Max     |
|----------------------------|--------|--------|--------|--------|---------|
| Physical workload (NAS)    | 72.84% | 22.07% | 78.07% | 24.30% | 111.03% |
| Mental workload (NASA-TLX) |        |        |        |        |         |
| Mental demands             | 72.68  | 12.44  | 73.33  | 41.67  | 93.33   |
| Physical demands           | 77.73  | 11.99  | 78.33  | 50     | 98.33   |
| Temporal demands           | 69.25  | 14.46  | 70.00  | 36.67  | 95.00   |
| Perceived performance      | 45.53  | 25.01  | 46.66  | 5.00   | 95      |
| Effort                     | 75.20  | 14.56  | 76.66  | 28.33  | 96.67   |
| Frustration                | 52.80  | 21.07  | 53.33  | 5.00   | 98.33   |
| Total mental workload      | 70.21  | 12.36  | 71.33  | 42.89  | 95.23   |

Abbreviations: NAS, nursing activities score; NASA-TLX, NASA Task Load Index.

A systematic review found that the lowest (36.1%) and the highest (109.3%) NAS documented in Greek and Iranian ICUs, respectively (Esmaeili et al., 2015).

The findings of our study showed that the mean of the ICU nurses' mental workload was 70.21. Also, in the mental workload dimensions, the physical demands and the perceived performance had the highest and lowest scores, respectively. However, findings from a study using the NASA-TLX completed in 8 hospitals and 21 ICUs (757 nurse participants) revealed the highest mental workload for nurses was related to the mental demands of patient care and the lowest was related to frustration in relation to daily workload (Hoonakker et al., 2011). In another study, the mean mental workload of 480 nurses working in ICUs using the NASA-TLX was reported as 69.54, with the effort score being the highest and the frustration score the lowest (Sarsangi et al., 2015). In addition, the results of a recent study using the NASA-TLX with 94 nurse participants by Restuputri et al., (2019) in 15 hospital wards showed that the mental workload score of nurses working in the ICU was higher in comparison with all other wards. One of the reasons for the higher

mental nursing workload in ICUs may be due to the sensitivity of nurse duties in these units so that any error may cause significant and potentially serious life-threatening events for the patients under nurse care (Safari et al., 2013).

ICUs provide complex medical, nursing and therapeutic services for a range of serious health problems (Minvielle et al., 2008). Intensive care nurses work in demanding and stressful work settings and must carry out therapeutic procedures with precision, provide appropriate and quick responses to the needs of patients and families, and interact with the most severe emotional challenges relating to the preservation of life, or end of life care (Gurses & Carayon, 2007). Differences in the average nursing physical and mental workload components in the reviewed studies describing ICUs may be due to different quality of provided care, differences in the type of patients, differences in the nurse-to-patient ratio, different organizational protocols and regulations of care, and differences in the use of NAS and NASA-TLX scales by researchers (Esmaeili et al., 2015; Moghadam et al., 2020; Strazzieri-Pulido et al., 2019). In addition, organizational research has shown that

**TABLE 3** Bivariate correlations between the nursing physical and mental workload dimensions, as well as among mental workload dimensions in ICUs

| Characteristics           | 1 | 2      | 3       | 4       | 5      | 6       | 7       | 8       |
|---------------------------|---|--------|---------|---------|--------|---------|---------|---------|
| 1 Physical workload (NAS) | 1 | 0.29** | 0.57*** | 0.45*** | 0.25** | 0.54*** | 0.35*** | 0.61*** |
| 2 Mental demands          |   | 1      | 0.60*** | 0.66*** | 0.02   | 0.56*** | 0.34*** | 0.64*** |
| 3 Physical demands        |   |        | 1       | 0.70*** | 0.18   | 0.76*** | 0.47*** | 0.82*** |
| 4 Temporal demands        |   |        |         | 1       | 0.25** | 0.71*** | 0.49*** | 0.82*** |
| 5 Perceived performance   |   |        |         |         | 1      | 0.28**  | 0.20*   | 0.53*** |
| 6 Effort                  |   |        |         |         |        | 1       | 0.52*** | 0.83*** |
| 7 Frustration             |   |        |         |         |        |         | 1       | 0.57*** |
| 8 Total mental workload   |   |        |         |         |        |         |         | 1       |

Note: Pearson's correlations were used.

Abbreviation: NAS, nursing activities score.

\* $p < .05$ .

\*\* $p < .01$ .

\*\*\* $p < .001$

**TABLE 4** Association between the physical and mental workload with each other and individual and occupational characteristics of ICU nurses

| Nurses characteristics                           | Physical workload (NAS) |                |         | Mental workload (NASA-TLX) |               |         |
|--------------------------------------------------|-------------------------|----------------|---------|----------------------------|---------------|---------|
|                                                  | b                       | 95% CI         | p-value | B                          | 95% CI        | p-value |
| Physical workload (NAS)                          | -                       | -              | -       | 0.41                       | 0.21, 0.60    | <.001   |
| Mental workload (NASA-TLX)                       | 0.33                    | 0.17, 0.49     | <.001   | -                          | -             | -       |
| Female                                           | 0.20                    | -9.36, 9.77    | .96     | -8.10                      | -18.58, 2.36  | .12     |
| Age (ref <sup>a</sup> to <30)                    |                         |                |         |                            |               |         |
| 30-40                                            | 1.86                    | -3.50, 7.50    | .49     | 0.84                       | -5.11, 6.80   | .78     |
| >40                                              | -0.10                   | -13.76, 13.55  | .98     | -5.83                      | -20.91, 9.23  | .44     |
| Married                                          | -1.71                   | -5.14, 1.72    | .33     | -1.54                      | -5.36, 2.26   | .42     |
| Educational level (ref <sup>a</sup> to Bachelor) |                         |                |         |                            |               |         |
| Master                                           | 1.04                    | -5.82, 7.91    | .76     | -3.53                      | -11.10, 4.04  | .36     |
| Work experience                                  | 0.36                    | -0.26, 0.99    | .25     | -0.14                      | -0.84, 0.55   | .68     |
| Weekly working hours                             | 0.14                    | -0.10, 0.39    | .24     | 0.10                       | -0.16, 0.38   | .44     |
| Being employed at the other healthcare centres   | 3.74                    | -0.80, 8.29    | .10     | -3.76                      | -8.81, 1.27   | .14     |
| Resting before the work shift                    | 0.14                    | -0.18, 0.46    | .08     | 0.03                       | -0.10, 0.17   | .65     |
| Resting after the work shift                     | 0.001                   | -0.14, 0.14    | .99     | 0.05                       | -0.10, 0.20   | .52     |
| Number of patients under care                    | 25.47                   | 19.60, 31.34   | <.001   | -7.35                      | -15.67, 0.97  | .08     |
| Type of ICU (ref <sup>a</sup> to General ICUs)   |                         |                |         |                            |               |         |
| Neurosurgical                                    | -6.65                   | -11.25, -2.05  | .005    | -4.15                      | -9.37, 1.07   | .11     |
| Cardiac surgery                                  | -10.58                  | -16.51, -4.65  | <.001   | -10.06                     | -16.73, -3.40 | .003    |
| Obstetric surgery                                | -29.94                  | -36.39, -23.49 | <.001   | 2.53                       | -7.00, 12.06  | .60     |
| Burn                                             | -26.80                  | -36.08, -17.51 | <.001   | 0.46                       | -11.26, 12.19 | .93     |

Note: b, Coefficient was obtained according to the multivariable linear regression.

Abbreviations: CI, confidence interval; NAS, Nursing Activities Score; NASA-TLX: NASA Task Load Index.

<sup>a</sup>Reference group.

work units' culture and climate have an important role in the perceived workload and performance of healthcare professions in ICUs (Minvielle et al., 2008). Previous literature has suggested that positive teamwork cultural values may be associated with a low level of mental and physical workloads than technical and task-based work among nurses (Le Blanc et al., 2010; Yanchus et al., 2017). Moreover, differences in mental workload dimensions may lie in the fact that mental workload is affected by many factors such as resources available to support patient care, nurses' well-being and effective patterns of workload and distribution within teams (Tubbs-Cooley et al., 2018).

Our study identified a positive significant association between both physical workload and all dimensions of mental workload as well as total mental workload for ICU nurses. In an extensive literature review, we only found one study that investigated simultaneously physical and mental workload using the NASA-TLX with ICU nurses (Hoonakker et al., 2011). Similar to the findings of our study, Hoonakker et al., (2011) study showed that the NAS was relatively correlated with the NASA-TLX. However, Restuputri et al., (2019) concurrently examined the mental workload using the NASA-TLX

and the physical workload using the heart rate reserve percentage but the significant relationship between them was not reported.

In the current study, all dimensions of mental workload and total mental workload were significantly correlated with each other except mental and physical demands with perceived performance. Consistent with our results, the findings of Sarsangi et al., (2015) study also evidenced a significant relationship between dimensions of mental workload in ICU nurses using the NASA-TLX. In addition, another study showed that the various dimensions of the NASA-TLX were completely related except perceived performance which was only associated with frustration (Hoonakker et al., 2011). Taking action to reduce each of the dimensions of mental workload stress for ICU nurses has the potential to decrease stress in other aspects of the nursing role, thereby reducing the total mental workload (Sarsangi et al., 2015).

The findings of our study indicated an inverse significant association between the physical workload and working in obstetric surgery, burns, cardiac surgery and neurosurgical ICUs. In line with our findings, Lucchini et al., (2014) reported that the mean NAS of patients in general ICUs was higher than for patients admitted to the cardiac and neurosurgery ICUs. Also, a high NAS average (96.24%) in general



ICUs was reported in Stafseth et al., (2011) study. Moreover, another study used the Therapeutic Intervention Scoring System-28 (TISS-28) to evaluate nursing workload in ICUs and results revealed that nursing workload in surgical and burns ICUs was lower than general ICUs (Padilha et al., 2007). This finding may be due to the diversity of patients admitted to the general ICUs and the need for wide-ranging nursing skills to care for these patients (Lucchini et al., 2014).

In the present study, an inverse relationship was seen between the mental workload of nurses and working in a cardiac surgery ICU. Inconsistent with our findings, the results of a study by Hoonakker et al., (2011) found that the total mental workload in cardiac ICUs is significantly higher than in other ICUs. In the present study, the patient-to-nurse ratio in the cardiac surgery ICU was 1:1, while in the other ICUs this ratio was 2:1 or 3:1. Naturally, with the increase in the number of patients under care the responsibility of the nurse has become heavier which inevitably increases the workload (Coventry et al., 2015).

#### 4.1 | Strengths and limitations

Our study was the second study that simultaneously measured the physical and mental workload of nurses in ICUs and therefore different from previous studies. Nevertheless, there were some limitations to our study that should be considered while interpreting our findings. Firstly, we used a cross-sectional design in this study; thus, the results show correlation and do not prove causation. Secondly, data were gathered only in ICUs in one of the urban areas of Iran, which could limit the generalizability of the findings to other countries. Thirdly, in the international literature there have been few studies investigating the simultaneous investigation of mental and physical workload in ICUs nurses that did not allow us to fully compare the results.

### 5 | CONCLUSION

Our study indicated that the mental and physical workload of nurses working in ICUs was relatively high and that there was a significant relationship between them. Therefore, taking interventions to reduce the mental workload challenges can have a significant impact on reducing the physical workload and vice versa. The identified differences in nursing mental and physical workload according to the type of ICU show the need to pay attention to the patient-to-nurse ratio and its coordination of workload. Future research can focus on gathering more clinical data in order to extend our study findings about the relationship between nursing mental and physical workload.

### 6 | IMPLICATION FOR PRACTICE

The findings from our investigation add to current knowledge about the mental and physical workload for nurses working in ICUs and

the relationship between these factors. The findings can be used by nursing and hospital managers to estimate the specific nursing mental and physical workload requirements necessary to enable the best patient care in an ICU. The obtained findings related to physical and mental workload related to different types of ICUs can be useful when planning staff-patient allocation and when considering nurse quality of life and well-being.

Due to the high level of physical and mental workload experienced by nurses in ICU and the positive relationship between these two factors, it is suggested that an increase in the number of nurses in ICUs, rotation of ICU nurses between ICUs and other wards, and creation of a strong teamwork culture can reduce physical and mental workload and prevent burnout among nurses. In addition, providing educational programmes for nurses about factors to improve how they manage their workloads such as time management and sleep hygiene techniques may be important and useful strategies to improve patients' quality of care and nurses' well-being.

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#### CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

#### AUTHOR CONTRIBUTIONS

KNM, MMC, SRM: Conceptualization. KNM, MM: Data curation. AM, SA, MM: Formal analysis and software provision. SRM: Funding acquisition. KNM: Investigation of study. KNM, MMC, SRM, AM: Methodology. MMC, SRM: Project administration and supervision of study. KNM, MMC, SRM: Resource provision. AM, CH: Validation of data. MM, AM, CH: Roles/writing—original draft. MM, AM, CH: Writing review and editing.

#### ETHICAL APPROVAL

The protocol of the study was reviewed by the Guilan University of Medical Sciences and approved under the code of IR. GUMS. REC.1394.286.

#### DATA AVAILABILITY STATEMENT

The data sets used for the current study are available from the corresponding author on reasonable request.

#### ORCID

Abbas Mardani  <https://orcid.org/0000-0003-2861-6037>

#### REFERENCES

- Alizadeh, M., Heidari Gorji, M. A., Khalilian, A. R., & Esmaeili, R. (2015). Assessment of nursing workload and related factors in intensive care units using the nursing activities score. *Journal of Mazandaran University of Medical Sciences*, 24(122), 147–157.

- Amin, S. G., Fredericks, T. K., Butt, S. E., & Kumar, A. R. (2014). *Measuring mental workload in a hospital unit using EEG-A pilot study*. IIE Annual Conference. Proceedings.
- Aprilia, T. D., Somantri, I., & Mirwanti, R. (2019). Nurses' mental workload in critical care rooms and emergency department. *Journal of Nursing Care*, 2(3), 159–166.
- Carlesi, K. C., Padilha, K. G., Toffoletto, M. C., Henriquez-Roldán, C., & Juan, M. A. C. (2017). Patient safety incidents and nursing workload. *Revista latino-americana De Enfermagem*, 25, e2841. <https://doi.org/10.1590/1518-8345.1280.2841>
- Carmona-Monge, F. J., Jara-Perez, A., Quiros-Herranz, C., Rollan-Rodriguez, G., Cerrillo-Gonzalez, I., Garcia-Gomez, S., Martinez-Lareo, M., & Marin-Morales, D. (2013). Assessment of nursing workload in three groups of patients in a Spanish ICU using the Nursing Activities Score Scale. *Revista Da Escola De Enfermagem Da USP*, 47(2), 335–340. <https://doi.org/10.1590/S0080-62342013000200009>
- Chang, L.-Y., Yu, H.-H., & Chao, Y.-F. (2019). The relationship between nursing workload, quality of care, and nursing payment in intensive care units. *The Journal of Nursing Research*, 27(1), 1–9. <https://doi.org/10.1097/jnr.0000000000000265>
- Coventry, T. H., Maslin-Prothero, S. E., & Smith, G. (2015). Organizational impact of nurse supply and workload on nurses continuing professional development opportunities: An integrative review. *Journal of Advanced Nursing*, 71(12), 2715–2727. <https://doi.org/10.1111/jan.12724>
- Debergh, D. P., Myny, D., Van Herzele, I., Van Maele, G., Miranda, D. R., & Colardyn, F. (2012). Measuring the nursing workload per shift in the ICU. *Intensive Care Medicine*, 38(9), 1438–1444. <https://doi.org/10.1007/s00134-012-2648-3>
- Esmaili, R., Moosazadeh, M., Alizadeh, M., & Afshari, M. (2015). A systematic review of the workload of nurses in intensive care units using NAS. *Acta Medica Mediterranea*, 31(7), 1455–1460.
- Fagerström, L., Kinnunen, M., & Saarela, J. (2018). Nursing workload, patient safety incidents and mortality: An observational study from Finland. *British Medical Journal Open*, 8(4), e016367. <https://doi.org/10.1136/bmjopen-2017-016367>
- Gurses, A. P., & Carayon, P. (2007). Performance obstacles of intensive care nurses. *Nursing Research*, 56(3), 185–194. <https://doi.org/10.1097/01.NNR.0000270028.75112.00>
- Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. P.A. Hancock & N. Meshkati In *Advances in psychology* (Vol. 52, pp. 139–183). Elsevier.
- Hoonakker, P., Carayon, P., Gurses, A. P., Brown, R., Khunlertkit, A., McGuire, K., & Walker, J. M. (2011). Measuring workload of ICU nurses with a questionnaire survey: The NASA task load index (TLX). *IIE Transactions on Healthcare Systems Engineering*, 1(2), 131–143. <https://doi.org/10.1080/19488300.2011.609524>
- Koca, D., Yıldız, S., Soyupek, F., Günyeli, İ., Erdemoglu, E., Soyupek, S., & Erdemoglu, E. (2015). Physical and mental workload in single-incision laparoscopic surgery and conventional laparoscopy. *Surgical Innovation*, 22(3), 294–302. <https://doi.org/10.1177/1553350614556363>
- Le Blanc, P. M., Schaufeli, W. B., Salanova, M., Llorens, S., & Nap, R. E. (2010). Efficacy beliefs predict collaborative practice among intensive care unit nurses. *Journal of Advanced Nursing*, 66(3), 583–594. <https://doi.org/10.1111/j.1365-2648.2009.05229.x>
- Liu, L.-F., Lee, S., Chia, P.-F., Chi, S.-C., & Yin, Y.-C. (2012). Exploring the association between nurse workload and nurse-sensitive patient safety outcome indicators. *Journal of Nursing Research*, 20(4), 300–309. <https://doi.org/10.1097/jnr.0b013e3182736363>
- Lucchini, A., De Felippis, C., Elli, S., Schifano, L., Rolla, F., Pegoraro, F., & Fumagalli, R. (2014). Nursing Activities Score (NAS): 5 years of experience in the intensive care units of an Italian University hospital. *Intensive and Critical Care Nursing*, 30(3), 152–158. <https://doi.org/10.1016/j.iccn.2013.10.004>
- Mehta, R. K., & Agnew, M. J. (2012). Influence of mental workload on muscle endurance, fatigue, and recovery during intermittent static work. *European Journal of Applied Physiology*, 112(8), 2891–2902. <https://doi.org/10.1007/s00421-011-2264-x>
- Minvielle, E., Aegerter, P., Dervaux, B., Boumendil, A., Retbi, A., Jars-Guincestre, M. C., & Guidet, B. (2008). Assessing organizational performance in intensive care units: A French experience. *Journal of Critical Care*, 23(2), 236–244. <https://doi.org/10.1016/j.jcrc.2007.11.006>
- Miranda, D. R., Nap, R., de Rijk, A., Schaufeli, W., Iapichino, G., & Group, M. o. t. T. W. (2003). Nursing activities score. *Critical Care Medicine*, 31(2), 374–382. <https://doi.org/10.1097/01.CCM.0000045567.78801.CC>
- Moghadam, K. N., Chehrzad, M. M., Masouleh, S. R., Mardani, A., Maleki, M., Akhlaghi, E., & Harding, C. (2020). Nursing workload in intensive care units and the influence of patient and nurse characteristics. *Nursing in Critical Care*, 1–7. <https://doi.org/10.1111/nicc.12548>
- Mohammadi, M., Mazloumi, A., Kazemi, Z., & Zeraati, H. (2015). Evaluation of mental workload among ICU ward's nurses. *Health Promotion Perspectives*, 5(4), 280.
- Mohammadi, M., Mazloumi, A., & Zeraati, H. (2013). Designing questionnaire of assessing mental workload and determine its validity and reliability among ICUs nurses in one of the TUMS's hospitals. *Journal of School of Public Health and Institute of Public Health Research*, 11(2), 87–96.
- Padilha, K. G., Sousa, R. M. C., Kimura, M., Miyadahira, A. M. K., da Cruz, D. A. L. M., de Fátima Vattimo, M., Fusco, S. R. G., de Campos, M. E. F., Mendes, E. M. T., & Mayor, E. R. C. (2007). Nursing workload in intensive care units: A study using the therapeutic intervention scoring system-28 (TISS-28). *Intensive and Critical Care Nursing*, 23(3), 162–169. <https://doi.org/10.1016/j.iccn.2006.07.004>
- Padilha, K. G., Stafseth, S., Solms, D., Hoogendoorn, M., Monge, F. J. C., Goma, O. H., Giakoumidakis, K., Giannakopoulou, M., Gallani, M. C., Cudak, E., Nogueira, L. D. S., Santoro, C., Sousa, R. C. D., Barbosa, R. L., & Miranda, D. D. R. (2015). Nursing activities score: An updated guideline for its application in the intensive care unit. *Revista Da Escola De Enfermagem Da USP*, 49, 131–137. <https://doi.org/10.1590/S0080-623420150000700019>
- Pereira Lima Silva, R., Gonçalves Meneguetti, M., Dias Castilho Siqueira, L., Araújo, T. R., Auxiliadora-Martins, M., Mantovani Silva Andrade, L., & Laus, A. M. (2020). Omission of nursing care, professional practice environment and workload in intensive care units. *Journal of Nursing Management*, 28(8), 1–11. <https://doi.org/10.1111/jonm.13005>
- Restuputri, D. P., Pangesti, A. K., & Garside, A. K. (2019). The measurement of physical workload and mental workload level of medical personnel. *Jurnal Teknik Industri*, 20(1), 34–44.
- Safari, S., Mohammadi-Bolbanabad, H., & Kazemi, M. (2013). Evaluation mental work load in nursing critical care unit with national aeronautics and space administration task load index (NASA-TLX). *Journal of Health System Research*, 9(6), 613–619.
- Sarsangi, V., Saberi, H., Hannani, M., Honarjoo, F., SalimAbadi, M., Goroohi, M., & Kazemi, H. (2015). Mental workload and its affected factors among nurses in Kashan province during 2014. *Journal of Rafsanjan University of Medical Sciences*, 14(1), 25–36.
- Stafseth, S. K., Solms, D., & Bredal, I. S. (2011). The characterisation of workloads and nursing staff allocation in intensive care units: A descriptive study using the nursing activities score for the first time in Norway. *Intensive and Critical Care Nursing*, 27(5), 290–294. <https://doi.org/10.1016/j.iccn.2011.07.003>
- Strazzieri-Pulido, K. C., S. González, C. V., Nogueira, P. C., Padilha, K. G., & G. Santos, V. L. C. (2019). Pressure injuries in critical patients: Incidence, patient-associated factors, and nursing workload. *Journal of Nursing Management*, 27(2), 301–310. <https://doi.org/10.1111/jonm.12671>
- Tubbs-Cooley, H. L., Mara, C. A., Carle, A. C., & Gurses, A. P. (2018). The NASA task load index as a measure of overall workload among



- neonatal, paediatric and adult intensive care nurses. *Intensive and Critical Care Nursing*, 46, 64–69. <https://doi.org/10.1016/j.iccn.2018.01.004>
- Tubbs-Cooley, H. L., Mara, C. A., Carle, A. C., Mark, B. A., & Pickler, R. H. (2019). Association of nurse workload with missed nursing care in the neonatal intensive care unit. *JAMA Pediatrics*, 173(1), 44–51. <https://doi.org/10.1001/jamapediatrics.2018.3619>
- Waddill-Goad, S. M. (2019). Stress, fatigue, and burnout in nursing. *Journal of Radiology Nursing*, 38(1), 44–46. <https://doi.org/10.1016/j.jradnu.2018.10.005>
- Yanchus, N. J., Ohler, L., Crowe, E., Teclaw, R., & Osatuke, K. (2017). 'You just can't do it all': A secondary analysis of nurses' perceptions

of teamwork, staffing and workload. *Journal of Research in Nursing*, 22(4), 313–325. <https://doi.org/10.1177/1744987117710305>

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